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BTEC

Mark Scheme (Results)

June 2022

Pearson BTEC Nationals
In Applied Science (31627H)
Unit 5: Principles and Applications of Science II - Physics

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June 2022
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Unit 5: Principles and Applications of Science II

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

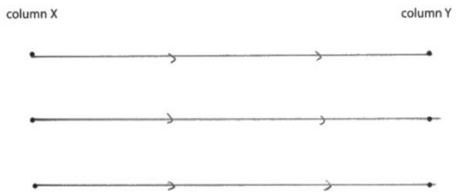
Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme

Question Number	Answer	Additional Guidance	Mark
1 (a)	C – The sum of the potential energy and kinetic energy of the molecules.		1
1 (b)	When an energy transfer takes place in a system, the **entropy** of the system increases Accept alternative words meaning entropy.	accept disorder/chaos/ disorganisation	1
1 (c)(i)	pressure {decreases/reduces/lowers/less} (1) as the air molecules will produce {less frequent collisions/collide less often} with the walls of the cylinder (1)	accept relieved ignore fewer/less collisions ignore collisions between particles	2
1 (c)(ii)	substitution (1) 150000 x 0.15 = 8.0 x 8.31 x T rearrangement (1) (T =) $\frac{150000 \times 0.15}{8.0 \times 8.31}$ evaluation (1) 338.45 (K)	allow for full marks 338.45(K) without working shown substitution and rearrangement can be in any order 22500 = 66.48T $\frac{22500}{66.48}$ $(T =) \frac{pV}{nR}$ accept 339 /338.5/338.448/338 for full marks 0.003/0.00296 gains two marks POT error loses 1 mark	3
		Total	7 marks

Question Number	Answer	Additional Guidance	Mark
2 (a)	D – Viscosity		1
2 (b)	parallel lines from X to Y  	lines must be roughly parallel by eye/not cross lines can start between the dots but must be parallel hand drawn lines must be straight by eye allow acceptable interpretations of lines not starting/ending at the LHS must be at least 2 lines no lines should cross or converge ignore arrows ignore dotted lines	1
2 (c)	Award **one** mark for identification and **three** marks for an expansion **identification** the air flow between the lorry and car is faster (than the air flow on the other side of each vehicle) (1) OR the air is moving in the opposite direction (to the vehicles) (1) **expansion** the air pressure is less (between the lorry and the car) (1) a pressure difference (is produced) (1) producing a (net inward) force (pulling the vehicles together) (1)	accept reference to Bernoulli's principle	4
		Total	6 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	transfers {thermal energy/heat energy} (in the water/steam) (1) into {kinetic energy/work} (in the turbine) (1)	allow converts or turns allow internal energy allow movement energy/mechanical energy ignore electrical energy or useful energy	2
3 (b)	**Identification** Turbine A is more efficient (1) **Expansion** (because) more (of the input) energy is converted into useful work/energy output (1) OR less energy is being lost/dissipated to the environment/elsewhere (1)	Allow RA throughout allow more effective allow greater or more, must be a comparative allow more work is done allow less energy wasted ignore answers relating to Coefficient of Performance, (COP)	2
3 (c)	substitution (1) $0.45 = 1 - \frac{1.2 \times 10^9}{Q_{in}}$ rearrangement (1) $Q_{in} = \frac{1.2 \times 10^9}{0.55}$ evaluation (1) 2.2×10^9 (J)	working must be shown reject 2.0×10^9 alone substitution and rearrangement can be in any order 2.66×10^9 for 2 marks accept 2181818182 or 2.18(2) $\times 10^9$ for 3 marks if no other marks seen allow 1 mark for calculating the difference 1-0.45 or 0.55 seen POT error -1 mark	3
		Total	7 marks

Question Number	Answer	Additional Guidance	Mark
4 (a)(i)	evaporation/evaporating	accept vapourisation	1
4 (a)(ii)	water molecules {gain (kinetic) energy/ move faster} (by heating from the sun) (1) molecules at the **surface** escape from the puddle (1)	allow particles for molecules throughout ignore molecules move freely and bonds being broken accept molecules/particles gain thermal energy	2
4 (b)(i)	substitution (1) $2.00 (x 10^6) = m \times 2.26 (x 10^6)$ rearrangement (1) $m = \frac{2.00 (x 10^6)}{2.26 (x 10^6)}$ evaluation (1) 0.885 (kg)	allow for full marks 0.885 (kg) without working shown substitution and rearrangement can be in any order allow full marks for 0.9 or 0.89 or 0.88496 or 0.88 allow 1.13 for 2 marks allow 1 mark if Q=mL seen if no other mark awarded POT error loses a mark	3
4 (b)(ii)	Identification and expansion in either order (all) energy goes into increasing PE of the molecules (1) moving the molecules apart / breaking bonds between (water) molecules / breaking intermolecular / hydrogen bonds} (1) (supplied) energy does not go into increasing the KE (of the molecules) (1)	accept particles for molecules throughout accept reducing forces between the molecules	2
		Total	8 marks

Question Number	Answer	Additional Guidance	Mark
5 (a)	B – N m^{-2}		1
5 (b)	B – Ductility		1
5 (c)	conversion (1) 65 cm to 0.65 m substitution (1) $5.0 = ½ k (0.65)^2$ rearrangement (1) $k = \frac{5.0}{0.5 \times (0.65)^2}$ evaluation (1) 24 (Nm^{-1})	allow for full marks 23.669 (Nm^{-1}) without working shown substitution and rearrangement can be in any order $k = \frac{5.0}{0.21125}$ OR $k = \frac{5.0}{0.5 \times 0.4225}$ allow 3 marks for 0.0023669 or 15.385 allow 23.669/ 23.7/23.67 for 4 marks 4225 seen anywhere scores 1 mark if no other mark scored	4

Question number	Indicative content
5 (d)	**Similarities:** • when stress/force/weight is applied to both a strain/extension is produced • both store (elastic potential) energy that can be released on unloading • both have an elastic section. **Differences:** • the steel wire is totally elastic (in the region shown in the graph) and the polythene bag is (partially elastic and) mainly plastic. • steel wire is not plastic in the region shown on the graph. • the wire will return to its original length. • the polythene bag will have a permanent strain or extension/ the steel wire has no permanent strain or extension (on the graph). • plastic materials retain some deformed shape as the unloading line does not return to the origin. • Hooke's law applies to elastic regions of both materials/only applies to plastic materials (very) near the origin • elastic materials have a linear stress-strain line. • steel wire is stronger than the plastic material as the line is steeper. • polythene shows hysteresis on the graph. • polythene transfers some energy into other forms (in the plastic region). • steel wire is stiffer ORA. ignore references to ductility, malleability, fatigue, brittleness, creep, hardness and density

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–2	• Adequate interpretation, analysis and/or evaluation of the scientific information with generalised comments being made. • Generic statements may be presented rather than linkages to the context being made so that lines of reasoning are unsupported or partially supported. • The comparison will contain some similarities and differences showing some structure and coherence.
Level	**Mark**	**Descriptor**
Level 2	3–4	• Good analysis, interpretation and/or evaluation of the scientific information. • Lines of argument mostly supported through the application of relevant evidence drawn from the context. • Demonstrate an awareness of both similarities and differences leading to a comparison which has a structure which is mostly clear, coherent and logical
Level 3	5–6	• Comprehensive analysis, interpretation and/or evaluation of all pieces of scientific information. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn from the context. • The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence.
		Total: 12 marks

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